ON THE MORPHOLOGY OF THE TRYPANOSOME (*T. NIGERIENSE*, N. SP.) FROM A CASE OF SLEEPING SICKNESS FROM EKET, SOUTHERN NIGERIA

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(*Received for publication* 25 *July*, 1913)

Early in 1912 attention was drawn to the presence of a disease resembling sleeping sickness in the Eket district of Southern Nigeria. Mr. S. A. Bill, of the Qua Ibo Mission, reported in February that a girl at a village called Ikot Offiong appeared to be suffering from trypanosomiasis. A medical officer (Dr. R. W. Gray) was accordingly despatched to the district to investigate this case, and to enquire into the presence of sleeping sickness in the neighbourhood of Eket. In May he was able to report that he had discovered two cases; and, as on further investigation the disease was found to be widespread, an isolation camp was established near Ikorobo. Up to the end of April, 1913, a total of 167 cases of sleeping sickness had been identified.

Sporadic cases of sleeping sickness are known to occur in many parts of Nigeria, and in certain districts the disease appears to be endemic. The writer has seen cases at Baro and Kateri in Northern Nigeria, but although trypanosomes were present in the peripheral blood of these patients, they did not appear to be ill. In Kabba province of Northern Nigeria it is said to be endemic, and along the course of the Garara river, where the writer had an opportunity of investigating the subject in 1910, it was well known, but apparently uncommon. Sleeping sickness does not seem to be of a virulent type in Nigeria, and it does not at present occur in epidemic form. To account for this fact it has been supposed that the disease must have existed for a great number of years, and that the natives must have acquired a relative immunity. Some such

explanation is necessary since sporadic cases have been identified in so many places, and the local conditions over so much of the country are so favourable for the spread of the disease.

Sleeping sickness as it occurs at Eket, however, presents some special features. It was thought, therefore, that a study of the trypanosome producing the disease might be of interest. For this purpose Dr. Foran, the medical officer in charge of the sleeping sickness investigations, very kindly sent the writer a guinea-pig which had been inoculated from one of his cases. On examination the trypanosome was found to possess some unusual morphological features which are, I think, of sufficient interest to place on record, in view of the peculiar clinical symptoms with which they are associated.

SLEEPING SICKNESS IN EKET DISTRICT

I am indebted to the official reports of Dr. P. F. Foran for the following account of the disease as it occurs at Eket.

Sleeping sickness has, apparently, been known to the natives of the district for a very long time. It has, indeed, existed beyond the memory of the oldest inhabitants. They state, however, that it has become more common lately, and this they attribute to the fact that the present generation is inclined to ignore certain old native laws that forbade an infected person to associate with his fellows. Two phases of the disease are recognised. The early phase, characterised by enlargement of the glands of the neck, is known as *nsipiton;* and the later phase, in which lethargy appears, is called *odongo-idap.** Cases in the former stage are common, but those that have advanced to the latter stage are comparatively rare. The disease appears to be mild, although a number of deaths are reported to occur annually. In September, 1912, Dr. Foran wrote, 'I have only heard of four deaths from sleeping sickness, yet

* The writer, in 1910, found that a similar distinction was observed by the natives of Northern Nigeria. The stage of glandular enlargement they termed *chiwan wiya* (neck sickness), and the stage of lethargy *chiwan berichi* (sleep sickness). Sleeping Sickness Bureau Bulletin, No. 27, p. 236.

nsipiton [the early, glandular, phase of the disease] is very common.' The duration is a matter of years. In the cases collected, symptoms had been present for from one to five years. The great majority of the patients are children or young adults, their ages ranging from about 6 to 18 years. The sexes are about equally affected.

The symptoms are as follows: As a rule the general health is good, there is no marked anaemia, and wasting is present in only a few cases. Irregular fever occurs, especially in the afternoon and evening, and is accompanied by headache and malaise, and terminates in sweating. The tongue is furred. The spleen is almost always enlarged. The expression of some patients is dull and vacant; and there may be oedema or drooping of the eyelids. Muscular tremors occasionally occur. Weakness or lassitude is always more or less well marked. Skin rashes—urticaria and erythema—are present in many cases; but they are also common in uninfected natives. Impotence and amenorrhoea are said to accompany the disease. Enlargement of the cervical and axillary glands is the most constant sign. The glands are freely movable, soft, and elastic; and on microscopical examination are found to contain trypanosomes. Enlarged glands in other sites, such as the groin, do not contain the parasites. On excision, the glands are found to be pale pink in colour. They do not contain pus, and it is noteworthy that those showing signs of induration are found to be free from trypanosomes. The natives believe that the disease is curable by the excision of the glands, an operation which their 'doctors' readily perform. Numerous healthy individuals bearing scars on their necks are to be met with who have, it is affirmed, been cured in this manner.* According to the natives the glandular phase of the disease (*nsipiton*) lasts for about four years before lethargic symptoms develop. From the fact that somnolence is not a common symptom, most of the patients appearing to be in the early stages, it is possible that many of them recover before this stage is reached.

Trypanosomes are found in the gland juice of practically every

* Compare the note on the excision of cervical glands by a native doctor in Kabba province, Northern Nigeria. Dr. W. Morrison. British Medical Journal, June 8th, 1912.

case, but, up to the present, they have not been detected in the peripheral blood. In a few cases presenting the appearances of advanced sleeping sickness trypanosomes have not been found at all. In them the glands are but little enlarged, and, as noted above, indurated glands are generally free from parasites.

The country around Eket is an undulating plateau covered with dense bush, and intersected by numerous waterways. It includes a good deal of swampy land. The district is densely populated. The towns consist of scattered compounds standing some distance apart, and closely surrounded by farms and banana trees. They are usually very dirty, and some cattle, and a good many pigs, goats, and fowls are kept in them. The towns are generally some distance away from the water-side. Their water supply is obtained at two or three spots, which are closely surrounded by bush and trees, and approached along a narrow shaded path. The children and young adults are the water-carriers, and Dr. Foran considers that this accounts for the majority of the cases of sleeping sickness occurring in young people. Tsetse flies are prevalent all over the district. Dr. J. J. Simpson records *G. palpalis* and *G. caliginea* from Eket in his map of Southern Nigeria, showing the distribution of the genus *Glossina;** but, according to Dr. Foran, *G. tachinoides* is also a common species, at any rate, during the months of September and October.† He has observed that the tsetse flies 'appear to follow pigs about more than any other animal, and it is generally easier to catch the flies where these animals are than at the water.'

THE STRAIN OF TRYPANSOME

The trypanosomes used in this investigation were found in the blood of a guinea-pig kindly sent to the writer from Eket by Dr. P. F. Foran. The guinea-pig had been inoculated with cerebro-spinal fluid from a case of sleeping sickness on March 5th, 1913, but the incubation period is not known. The animal reached Lagos on May 8th, 1913, and was found to be infected with

* Bulletin of Entomological Research, Vol. III, part 2, 1912.

† If true, this is a remarkable fact as *G. tachinoides* does not occur so near to the coast elsewhere in Southern Nigeria. It is generally only met with inland, beyond the forest zone.

trypanosomes. It appeared to be well, and, at the time of writing (June 11th, 1913), is still in good health, although it is now 97 days since the date of inoculation. The trypanosomes have never been very numerous in the blood. Their numbers have not sensibly increased during the last month. It is, therefore, impossible to tell to what stage the disease has at present advanced.

The red blood corpuscles of the host exhibit well marked polychromasia and basophilia. In many of them, too, irregularly shaped fragments are to be seen, which stain red with Gimesa's solution.

MORPHOLOGY OF THE TRYPANOSOME FROM EKET

In this paper the flagellar end of the trypanosome will be termed anterior, and the non-flagellar end posterior.

A—*Living, unstained.*

The trypanosome from Eket in the fresh condition, as seen in a drop of blood from an infected guinea-pig, appears as an elongated tapering body of almost homogeneous consistency. The micronucleus can sometimes be distinguished as a small refractile body. The movements are active. Some individuals, which appear to be stouter than the others, are relatively sluggish, and do not move actively about the field. Others, which are long and slender, vibrate exceedingly actively, and also move rapidly across the field of the microscope. The translatory movement seems to be spasmodic, the trypanosome suddenly gliding across the field after having been more or less stationary, but vibrating vigorously all the time, for some moments previously. As a rule, the flagellar end moves forwards in the translatory movements. The non-flagellar end appears to be blunt, the flagellar attenuated. The undulating membrane is conspicuous.

In blood that has been shed for some little time changes may be observed taking place in the form of some of the trypanosomes. The writer has watched these changes on several occasions. They always occurred in long slender parasites, and were accompanied by a diminution of the activity of the trypanosome. The non-flagellar end of the trypanosome appears to round off, and eventually the

body becomes almost spherical. These atypical parasites are occasionally met with in stained blood films. One is illustrated (Plate XXXIII, fig. 22).

B—*Fixed and stained.*

Method of fixation and staining.—The blood films were fixed either with absolute alcohol or with osmic acid. The forms of the trypanosome were found to be the same in either case, but with osmic acid fixation the appearance of the cytoplasm was different if the films were stained very deeply. All the films were stained with Giemsa's solution (about 30-35 drops in 10 c.c. of water); those fixed with alcohol being stained for one hour, and those fixed with osmic acid for from ten to fifteen minutes.

The longest trypanosome measured, up to the present, is 32μ, and the shortest 8μ.

Breadth.—The breadth of the trypanosomes at the widest part varies from 1μ to 2·5μ.

Shape.—The trypanosome when stained is seen to be polymorphic. Long slender forms, short stumpy forms, and intermediate forms are always present; but their relative proportions vary considerably from day to day. The trypanosomes have never been very numerous, and, as a rule, the long slender forms have predominated. The long slender forms are of two types. In the one type the blepharoplast is terminal, and the nucleus elongated (Plate XXXIII, fig. 1). In some specimens the nucleus appears to have a clear area in the middle which gives it the appearance of being made up of two pieces, and the body anterior to it is often attenuated. In the other type the blepharoplast is situated about 1μ from the posterior extremity, which is prolonged beyond it into a blunt snout (Plate XXXIII, figs. 2, 3). The intermediate forms are very variable in size and general appearance. Some are pointed at both ends, others have a blunt posterior extremity, which is occasionally rounded off like the head of a tadpole. The blepharoplast is either terminal or sub-terminal. The body ends anteriorly in a very short 'free' flagellum. The stumpy forms are exceedingly short in some instances (Plate XXXIII, figs. 11, 12), and may measure as little as 8μ. They are relatively very broad,

measuring about 2μ. At the anterior end there is a very short 'free' flagellum. The membrane is not broad. The posterior end is quite blunt, and the beginning of the flagellum may form the posterior border of the parasite. The blepharoplast, as a rule, lies at the edge of the trypanosome a little way in front of the posterior end of the body, and on the opposite edge the folds of the membrane pass forwards. The nucleus is large, and is sometimes placed at the extreme anterior end (Plate XXXIII, fig. 13).

From time to time, in films prepared in the usual way, there appear in the blood trypanosomes which have the flagellum free in its entire length (Plate XXXIII, figs. 14, 15). They have not been observed in unstained blood-films, and, indeed, they would be very difficult to make out in fresh preparations. It is, therefore, possible that they may be artefacts; but it is curious that they have never been seen before by the writer in any other animal, although he invariably prepares his blood films in exactly the same way. These forms are long slender trypanosomes with the blepharoplast situated some way from the extremity. The anterior end is drawn out into a filamentous termination. The body measures about 22μ, and the flagellum 31μ.

Contents of the Cell.—In well stained specimens the protoplasm is homogeneous in structure, neither granules nor vacuoles being present. In films that have been over-stained, especially if they have been fixed with osmic acid, both granules and vacuoles appear (Plate XXXIII, figs. 20, 21). The granules are coarse, and occur on both sides of the nucleus. Sometimes they almost fill up the body of the trypanosome.

The nucleus.—The nucleus is oval, and about 2·5μ in length. The nucleus of the long slender trypanosomes with a terminal blepharoplast has already been referred to. In the stumpy forms the nucleus is rounded, and is generally surrounded on all sides by a zone of protoplasm. The nucleus is situated near the centre of the body in the majority of the trypanosomes, but in a few, and these are always stumpy forms, it is placed anteriorly—that is, at the flagellar end (Plate XXXIII, fig. 13). This is an interesting feature, as it suggests that the position of the nucleus in the stumpy forms is an index of the virulence of the trypanosome. In the typical *T. gambiense* it is central, in the more virulent

T. rhodesiense it is sometimes posterior, and in this less virulent strain of Nigeria it is anterior.

Blepharoplast.—The position of the blepharoplast has already been mentioned. It is well marked, round, and deeply staining.

Undulating membrane.—In the long slender forms the undulating membrane is ample, and is thrown into a number of folds. In some it is apparently absent, and the flagellum is, in consequence, free in its whole length. The membrane is less folded in the stumpy and intermediate forms. In carefully prepared specimens the membrane can be followed almost to the extremity of the flagellum, even in the slender forms which at first sight appear to have a long 'free' flagellum (Plate XXXIII, fig. 4).

Flagellum.—The flagellum stains deeply. It is well marked in all forms, and in all forms the terminal portion is free—that is, projects beyond the protoplasm of the cell and the undulating membrane. As already stated, in some forms of long slender parasites, in stained preparations, the flagellum appears to be free in its entire length.

Curve of Measurements:—

In their paper entitled 'Further measurements of *Trypanosoma rhodesiense* and *T. gambiense*'[1] Prof. Stephens and Dr. Fantham have pointed out that in measuring trypanosomes it is advisable to confine observations to a single animal, as it is possible that the size of the parasite may vary in different hosts. They also recommend that the trypanosomes should be measured on ten consecutive days so as to obviate the errors due to the daily variation in the numbers of short and long forms. They suggest that 100 trypanosomes should be measured on each of the first ten days of the infection in a white rat. It has been impossible for me to follow this plan exactly because no white rats have been available, and, in the few animals that have been infected by sub-inoculation, the parasites have been extremely rare at the commencement of the disease, and have, indeed, been apparently absent altogether from the peripheral blood for several days at a time. I have, therefore, measured 100 trypanosomes on each of the ten days from the 96th day to the 105th day after inoculation in the original guinea-pig sent to me from Eket.

With this exception, I have endeavoured to follow the procedure of Stephens and Fantham as closely as possible, so that my figures might be comparable with those given by these authors for *T. rhodesiense* and *T. gambiense*.

Thin blood smears, dried in the air, were fixed in absolute alcohol and stained with Giemsa's solution. The trypanosomes were then drawn with a camera lucida, and the length of a line drawn through the middle of each was measured by the 'tangent line' method. This method is, I believe, the most accurate that has as yet been described.

In the following tables the results of these measurements are given in detail, so that a closer analysis than mere averages would permit may be made by anyone who should wish to do so. A summary of the measurements is added, and a table showing the distribution into the stumpy, intermediate, and long form groups of Bruce.

Table 3 shows the great variation in the number of intermediate and long forms of trypanosome on particular days. The variation is not, however, so great in the percentage of stumpy forms, ranging only between 66 % and 36 %. On comparing this table with that given by Stephens and Fantham, it will be seen that there is a lesser degree of variation in the figures for all three groups, and in particular the number of the intermediate forms is strikingly less. Intermediate forms, that is trypanosomes measuring from 22μ to 24μ, were indeed comparatively scarce, although actually they were among the most common lengths of parasite. The relatively slight degree of variation may have been due to the period to which the disease had advanced in this animal. The figures given by Stephens and Fantham referred to a rat during the first ten days of the disease, those dealt with in this paper were from a guinea-pig between the 96th and the 105th day after inoculation.

TABLE I.—Distribution in respect to length of 1,000 non-dividing individuals of trypanosome from a single guinea-pig

Day after inoculation		In Microns																											Averages	
		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Of each 20	Of each 100
96th day.	1	...	...	...	1	...	2	...	2	5	...	1	...	2	...	1	1	2	1	1	...	...	...	1	...	...	...	...	18·95	
	2	...	...	...	...	1	...	...	1	4	1	1	1	...	5	1	1	...	2	...	...	1	...	1	...	...	...	...	20·15	
	3	...	...	...	...	...	1	...	1	2	2	2	2	...	2	2	2	2	2	...	...	...	...	...	...	...	...	...	19·90	19·28
	4	...	...	1	...	1	...	2	2	2	1	1	1	2	1	2	1	1	2	...	...	...	...	...	...	...	...	...	18·40	
	5	...	...	1	...	1	1	2	1	1	...	...	2	2	2	2	1	2	1	1	...	...	...	...	...	...	...	...	19·00	
97th day.	6	...	...	...	...	...	...	1	...	...	...	...	1	2	2	4	2	2	2	2	1	...	1	...	...	...	...	...	22·75	
	7	...	...	...	...	...	...	1	...	1	1	2	1	...	2	3	2	1	...	2	1	2	1	...	...	...	...	...	22·20	
	8	...	...	...	1	...	2	...	...	1	2	1	1	1	2	3	1	1	1	1	...	2	...	...	...	...	...	...	21·25	22·20
	9	...	...	...	...	...	...	...	2	...	1	...	...	1	3	5	2	...	2	2	...	...	1	...	...	...	...	1	22·55	
	10	...	...	...	...	...	...	...	1	...	1	1	2	...	1	**2**	4	2	5	...	1	...	...	...	...	...	...	...	22·25	
98th day.	11	...	...	...	...	...	...	...	2	1	...	1	1	2	1	2	...	2	3	2	2	...	...	1	...	...	...	...	22·35	
	12	...	...	...	...	...	...	...	1	1	...	4	2	...	...	1	4	3	1	...	...	1	2	...	...	...	...	...	21·90	
	13	...	...	...	...	1	...	1	2	1	1	1	4	1	3	...	3	1	...	...	...	1	...	...	...	...	...	...	19·35	20·45
	14	1	...	...	1	...	...	...	2	2	4	...	2	2	1	...	...	...	1	1	2	...	...	1	...	...	...	...	19·15	
	15	...	1	...	...	...	1	...	2	1	2	3	1	...	1	2	1	3	...	...	1	1	...	...	...	...	...	...	19·50	
99th day.	16	...	...	...	...	1	1	1	1	...	...	2	...	...	...	...	...	2	2	1	1	3	2	2	1	...	...	...	23·70	
	17	...	...	...	...	1	...	...	...	...	2	1	2	...	...	1	2	1	...	4	...	3	2	...	...	1	...	...	23·60	
	18	...	...	...	1	...	...	...	...	...	2	5	1	1	3	2	...	1	1	...	1	...	...	2	...	...	...	...	20·85	22·99
	19	...	...	...	...	...	...	...	...	3	...	...	1	2	1	1	1	2	3	...	2	...	3	...	1	...	...	...	23·40	
	20	...	...	...	...	...	...	...	...	1	3	...	...	2	1	...	3	2	3	...	2	...	...	...	2	1	...	...	23·40	
100th day.	21	...	...	...	...	1	...	...	...	...	1	2	6	3	2	3	1	...	...	1	...	...	...	...	...	...	...	...	19·80	
	22	...	...	...	...	...	...	...	1	2	3	3	3	1	2	1	1	2	...	1	...	...	...	...	...	...	...	...	19·50	
	23	...	...	1	...	1	1	...	1	...	1	...	1	3	1	2	1	1	1	4	...	...	...	1	...	...	...	...	20·85	20·31
	24	...	...	...	1	...	...	...	1	2	1	2	2	1	1	5	1	...	...	...	2	...	1	...	...	...	...	...	20·30	
	25	...	...	...	...	...	...	2	2	...	...	3	1	2	1	1	...	2	2	1	2	...	...	1	...	...	...	...	21·10	

TABLE I.—*Continued*

Day after inoculation	In Microns																													Averages	
	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Of each 20	Of each 100
101st day. 26	...	...	...	...	...	...	...	...	...	2	2	1	1	3	3	2	3	...	...	2	...	1	...	...	...	...	...	21·95	
27	...	...	...	...	...	...	1	...	...	...	4	3	1	3	2	...	1	2	1	...	...	2	...	...	...	...	...	21·40	
28	...	...	...	...	1	1	1	1	...	2	...	2	3	...	1	...	1	1	3	1	2	...	...	...	...	...	...	20·90	21·14
29	...	...	...	...	1	...	1	1	...	2	2	2	1	...	1	1	3	2	2	1	...	...	...	...	...	...	...	20·75	
30	...	...	...	...	...	1	1	...	1	...	2	2	1	4	2	4	...	...	1	...	...	...	...	...	1	...	...	20·70	
102nd day. 31	...	...	...	...	...	...	...	1	2	2	...	2	...	...	1	1	1	2	3	2	1	1	...	1	...	...	...	22·90	
32	...	...	...	...	...	...	...	2	...	3	...	2	2	2	...	1	2	2	1	1	...	1	...	1	...	...	...	21·75	
33	...	...	...	...	...	...	...	2	3	3	1	...	...	1	...	...	4	2	...	2	...	...	1	1	...	...	...	21·45	22·96
34	...	...	...	...	...	...	...	1	...	1	...	2	2	1	...	...	1	1	4	1	...	1	...	3	2	...	...	24·85	
35	...	...	...	...	...	...	...	...	2	...	1	1	...	2	2	3	...	1	1	1	5	...	...	...	...	...	1	23·85	
103rd day. 36	...	...	...	...	...	...	...	1	3	...	3	1	4	1	...	1	...	2	1	2	...	...	...	1	...	...	...	21·05	
37	...	...	...	1	...	...	...	1	1	1	1	2	2	3	...	1	1	1	3	...	1	...	1	...	...	...	...	21·30	
38	...	...	...	...	...	...	...	1	1	2	5	...	4	1	...	...	3	1	...	...	...	...	1	1	...	...	...	21·60	20·80
39	...	...	...	...	...	...	2	1	1	2	...	1	1	4	...	2	1	...	...	2	1	1	1	...	...	...	...	21·35	
40	...	...	...	1	1	...	...	2	2	2	1	3	2	3	1	...	...	1	...	...	...	...	1	...	...	...	...	18·70	
104th day. 41	...	1	...	...	...	...	...	1	1	2	2	2	2	...	...	2	1	...	2	1	1	1	1	...	...	...	...	21·20	
42	...	...	...	1	...	...	1	...	...	2	1	1	1	1	2	1	...	3	2	2	1	...	...	...	...	1	...	22·30	
43	...	...	...	1	1	...	...	...	2	1	1	1	1	2	...	1	2	...	1	2	...	1	1	...	2	...	...	22·30	22·82
44	...	...	...	...	...	...	...	...	...	1	1	1	1	...	1	1	...	4	1	2	4	2	...	1	...	...	...	25·00	
45	...	...	...	...	...	1	1	1	...	1	1	...	1	4	...	...	1	...	2	2	...	1	1	2	...	...	1	23·30	
105th day. 46	...	...	...	...	...	...	...	1	1	3	1	2	2	...	2	3	...	1	...	3	1	...	...	...	...	...	...	21·25	
47	...	...	...	...	...	...	...	1	...	2	1	3	3	2	1	1	...	1	2	...	1	...	...	...	1	1	...	22·05	
48	...	...	...	...	1	...	...	...	...	1	4	3	1	2	...	2	2	...	1	...	1	1	...	1	...	...	...	21·40	21·91
49	...	...	...	...	...	...	...	...	1	2	2	1	1	4	...	...	1	2	1	...	...	3	2	...	...	...	...	22·80	
50	...	...	...	...	...	...	...	1	...	1	...	4	3	1	2	...	...	1	1	1	2	...	1	1	...	1	...	22·05	
Totals	1	2	3	8	14	10	21	42	51	64	74	84	64	85	65	64	61	67	58	48	31	32	21	17	8	2	3	Average length of 1,000 trypanosomes is 21·486μ	

TABLE II.—Summary of measurements (in microns) of the lengths of 1,000 individuals of the trypanosome from Eket, Southern Nigeria, from a single guinea-pig.

	Maximum	Minimum	Averages of each 100	Averages of each 20	Range of averages of each 20
1	30	11		18·95	
2	30	12		20·15	
96th day. 3	25	13	19·28	19·90	1·75
4	25	10		18·40	
5	26	10		19·00	
6	29	14		22·75	
7	29	14		22·20	
97th day. 8	29	12	22·20	21·25	1·50
9	34	15		22·55	
10	27	15		22·25	
11	30	15		22·35	
12	29	15		21·90	
98th day. 13	28	12	20·45	19·35	3·20
14	30	8		19·15	
15	28	9		19·50	
16	31	12		23·70	
17	32	12		23·60	
99th day. 18	30	11	22·99	20·85	2·85
19	31	16		23·40	
20	32	16		23·40	
21	26	12		19·80	
22	26	15		19·50	
100th day. 23	30	10	20·31	20·85	1·60
24	29	11		20·30	
25	30	14		21·10	

TABLE II.—*Continued*

	Maximum	Minimum	Averages of each 100	Averages of each 20	Range of averages of each 20
26	29	17		21·95	
27	29	14		21·40	
101st day 28	28	12	21·14	20·90	1·25
29	27	12		20·75	
30	31	13		20·70	
31	31	15		22 90	
32	31	15		21.75	
102nd day. 33	31	15	22·96	21·45	3·40
34	32	15		24·85	
35	34	16		23·85	
36	31	15		21·05	
37	30	11		21·30	
103rd day. 38	31	16	20·80	21·60	2·90
39	30	14		21·35	
40	30	11		18·70	
41	30	9		21·20	
42	33	11		22·30	
104th day. 43	32	11	22·82	22·30	3·80
44	31	17		25·00	
45	34	13		23·30	
46	28	15		21·25	
47	33	15		22·05	
105th day. 48	31	12	21·91	21·40	1·55
49	30	16		22·80	
50	32	14		22·05	
				Range=25·00−18·40=6·60	

TABLE III.—The trypanosome from Eket, Southern Nigeria, arranged in the three groups—(*a*) 21μ and under; (*b*) 22-24μ; (*c*) 25μ and over.

Day	96	97	98	99	100	101	102	103	104	105	Totals
Stumpy 8-21μ	66	36	58	39	62	54	41	67	43	57	523
Intermediate 22-24μ	21	35	22	18	21	24	16	8	12	13	190
Long 25-34μ	13	29	20	43	17	22	43	25	45	30	287
	100	100	100	100	100	100	100	100	100	100	1000

TABLE IV.—Comparison of the trypanosome from Eket, Southern Nigeria, and *T. gambiense* (as given by Stephens and Fantham).

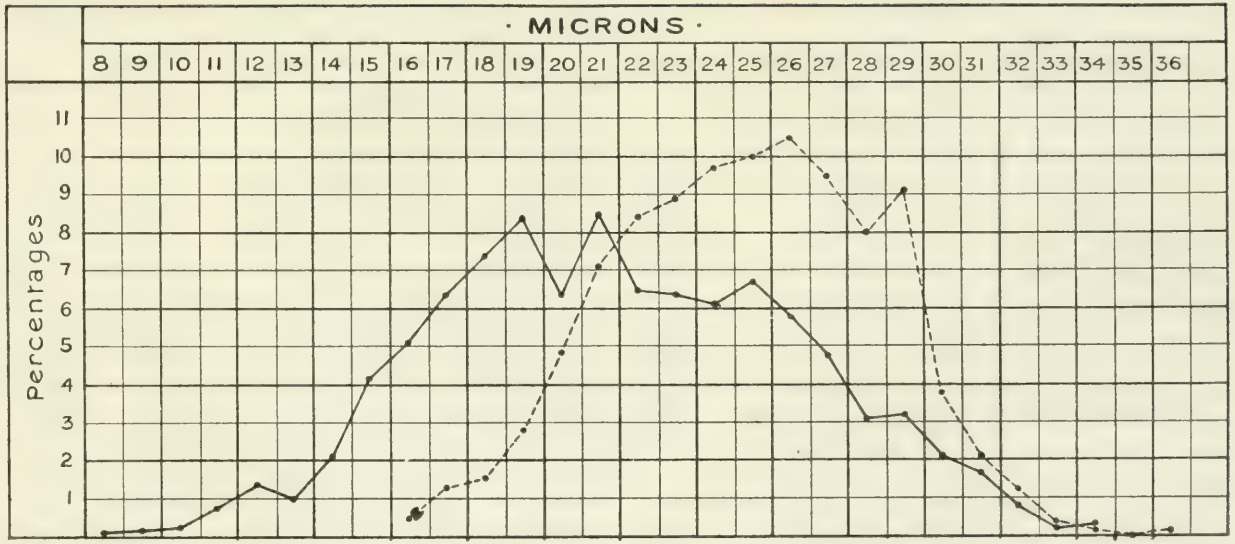
	Average	Maximum	Minimum	Under 22μ	22-24μ	25μ and over
T. gambiense	24·87μ	36·0μ	16·0μ	18·2 %	27·0 %	54·8 %
T. nigeriense	21·486μ	34·0μ	8·0μ	52·3 %	19·0 %	28·7 %

In Chart I a curve is given representing the distribution by percentages in respect to length of 1,000 non-dividing specimens of the trypanosome from Nigeria from a single guinea-pig. The curve given by Stephens and Fantham for *T. gambiense* is added on the chart to facilitate comparison.

The main object of the present investigation was to compare the measurements of the trypanosome from Southern Nigeria with those of a typical strain of *T. gambiense*. The figures have, therefore, been recorded in a manner that will permit of their being compared in detail with those given in what is, I believe, the latest exhaustive study of *T. gambiense*, that is, the paper by Stephens and Fantham already referred to repeatedly.

It will be observed that the trypanosome from Southern Nigeria is somewhat shorter than *T. gambiense;* the average length of

CHART No. I



Graphical representation of the distribution of the lengths of 1,000 trypanosomes from a guinea-pig infected at Eket (continuous line), and 1,000 *T. gambiense* from one rat (dotted line) according to Stephens and Fantham.

1,000 individuals being 21·486μ, as contrasted with 24·867μ. The maximum length of *T. gambiense* as given by Stephens and Fantham is 36·0μ, and the minimum 16·0μ, as compared with 34·0μ and 8·0μ in the case of the Nigerian trypanosome. The curve, too (Chart I), is strikingly different from that given by these authors for *T. gambiense*. It is lower and more extended, and reaches its main peak at 21μ, instead of at 26μ. At the far end, representing the exceptionally long parasites, the two curves almost coincide, but from this point backwards there is no agreement, and when the small forms are reached, the Nigerian trypanosome shows a very much higher percentage than that in the typical strain of *T. gambiense*. It has been already pointed out that the occurrence of these extremely small individuals is characteristic of this strain of human trypanosome.

ANIMAL REACTIONS

Dr. Foran, at Eket, injected a number of rats with blood and gland juice from cases of sleeping sickness, but none of them developed parasites. He used 'three kinds of rats in the experiments, namely, a large black house rat, a smaller brown bush rat, and a brown striped rat'; but 'all appeared to be immune.'

The animal reactions of the trypanosome are at present under investigation. It will, however, be some time before anything definite can be said about them, as the strain seems to be but slightly pathogenic. The following table embodies the results so far obtained:—

Animal		Days since inoculation, up to July 8	Day on which trypanosomes were first detected	Remarks
Guinea-pig	1	124	?	Alive and well. Trypanosomes numerous. The original animal from Eket.
,,	2	56	...	Has never shown trypanosomes. Alive and well.
,,	16	15	...	Died on 15th day. Never showed trypanosomes. Tissues nil.
,,	17	34	...	Has never shown trypanosomes. Alive and well.
,,	22	24	...	Has never shown trypanosomes. Alive and well.
,,	23	24	...	Has never shown trypanosomes. Alive and well.
Mouse	7	28	...	Died on 28th day. Never showed trypanosomes. Tissues nil.
,,	24	16	4	Trypanosomes always very scanty and sometimes absent. Alive and well.
,,	26	10	6	Trypanosomes scanty. Accidentally killed on 10th day.
,,	31	10	8	Trypanosomes very scanty. Alive and well.
,,	32	6	...	Trypanosomes not yet seen. Alive and well.
,,	34	6	...	Trypanosomes not yet seen. Alive and well.
,,	35	6	...	Trypanosomes not yet seen. Alive and well.
Goat	11	34	...	Has never shown trypanosomes. Alive and well.
,,	12	34	...	Has never shown trypanosomes. Alive and well.
Dog	13	34	...	Has never shown trypanosomes. Alive and well.
,,	14	34	...	Has never shown trypanosomes. Alive and well.
Monkey	21	22	10	Trypanosomes always scanty and sometimes absent. Alive and well.

SUMMARY AND CONCLUSIONS

The trypanosome, of which a preliminary account is given in this paper, seems to differ in several respects from a typical strain of *T. gambiense*. In man it produces a form of sleeping sickness that is relatively mild, occurs most commonly in young people, and in which the trypanosomes are, apparently, either absent from the peripheral blood altogether, or present in such small numbers that hitherto they have not been detected. To the smaller laboratory animals the strain seems to be but slightly pathogenic. The morphology of the trypanosome as it appears in the blood of a guinea-pig shows some peculiar features. The trypanosome is smaller than *T. gambiense*, the cell protoplasm when well stained is homogeneous, and there appear constantly in the blood films a few very minute parasites measuring as little as 8μ in length. Some of the short and stumpy parasites have the nucleus situated far forwards at the anterior (flagellar) end of the body. The occurrence of a few peculiar trypanosomes which appear to have a flagellum free in its whole length is also remarkable.

Considering the morphological features of the parasite, and the peculiar symptoms of the disease produced by it, I am convinced that this trypanosome from Nigeria cannot be regarded as belonging to the same species as *T. gambiense*. I therefore propose for it the name *T. nigeriense*.

We regret that it has been found impossible to reproduce Dr. Scott-Macfie's Plate in this number, but it will appear in the next.—[EDS.]

REFERENCE

1. STEPHENS, J. W. W. and FANTHAM, H. B. Further Measurements of *Trypanosoma rhodesiense* and *T. gambiense*. Annals of Tropical Medicine and Parasitology, Vol. VII, No. 1, 1913.

Volume VII November, 1913 No. 3B.

ANNALS
OF
TROPICAL MEDICINE AND PARASITOLOGY

ISSUED BY

THE LIVERPOOL SCHOOL OF TROPICAL MEDICINE

Edited by

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PROFESSOR R. NEWSTEAD, M.Sc., J.P., F.R.S., A.L.S., F.E.S., Hon. F.R.H.S.

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C. Tinling & Co., Ltd.
Printers to the University Press of Liverpool
53 Victoria Street